PHASE I

Geology, Energy, and Mineral (GEM) Resource Evaluation of Cache Creek GRA, Oregon, Idaho, Washington, including the Cache Creek Ranch (6-10) Wilderness Study Area

Bureau of Land Management

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Bureau of Land Management
Contract No. YA-553-CT2-1039

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ANCHORAGE, ALASKA
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WGM INC.
MINING AND GEOLOGICAL CONSULTANTS

EXECUTIVE SUMMARY

The Cache Creek Geology, Energy, and Mineral Resource Area (GRA) is located in the Snake River Canyon region at the common border of Oregon, Washington, and Idaho. The GRA includes one Wilderness Study Area, the Cache Creek Ranch WSA (6-10), a four-part WSA encompassing 2,935 acres.

Bedrock in the area consists of Permo-Triassic volcanic, volcaniclastic, epiclastic, and carbonate rocks unconformably overlain by Tertiary Columbia River basalts. The Cache Creek Ranch WSA (6-10) is underlain by basalts and Permo-Triassic rock units.

Metallic mineral occurrences are restricted to terrane underlain by Permo-Triassic units. One deposit and a number of occurrences of copper, lead, zinc, gold, and silver are known. At Lime Hill, in the extreme northern part of the GRA limestone has been exploited for cement.

The area is considered to be favorable for metallic mineral resources and unfavorable for non-metallic mineral, oil and gas, uranium, and geothermal resources. Classifications are summarized in the attached Table.

SUMMARY OF GEM RESOURCES

LAND CLASSIFICATION FOR THE CACHE CREEK GRA

	Cache Creek Ranch WSA (6-10)
1. Locatable Resources	
a. Metallic Minerals	3B
b. Uranium and Thorium	1B
c. Non-Metallic Minerals	2C
2. Leasable Resources	
a. Oil and Gas	1C
b. Low Temperature Geothermal	1B
High Temperature Geothermal	1B
c. Sodium and Potassium	
d. Other	1C
3. Saleable Resources	2D (sand and gravel) 2B (pumice and cinders)

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CACHE CREEK GRA, OREGON, WASHINGTON, AND IDAHO

1.0 INTRODUCTION

The Bureau of Land Management has adopted a two-phase procedure for the integration of geological, energy and mineral (GEM) resources data into the suitable/non-suitable decision making process for Wilderness Study Areas (WSAs). The objective of Phase I is the evaluation of existing data, both published and available unpublished data, and evaluation of the data for interpretation of the GEM resources potential of the WSAs. Wilderness Study Areas are grouped into areas based on geologic environment and mineral resources for initial evaluation. These areas are referred to as Geology, Energy, Mineral Resource Areas (GRAs).

The delineation of the GRAs is based on three criteria: (1) a 1:250,000 scale of each GRA shall be no greater than 8½ x 11 inches: (2) a GRA boundary will not cut across a Wilderness Study Area; and (3) the geologic environment and mineral occurrences. The data for each GRA is collected, compiled, and evaluated and a report prepared for each GRA. Each WSA in the GRA is then classified according to GEM resources favorability. The classification system and report format are specified by the BLM to maintain continuity between regions.

This report is prepared for the Bureau of Land Management under contract number YA-553-CT2-1039. The contract covers GEM Region 2; Northern Rocky Mountains (Fig. 2). The Region includes 50 BLM Wilderness Study Areas

totalling 583,182 acres. The WSAs were grouped into 22 GRAs for purposes of the Phase I GEM resources evaluation.

1.1 Location

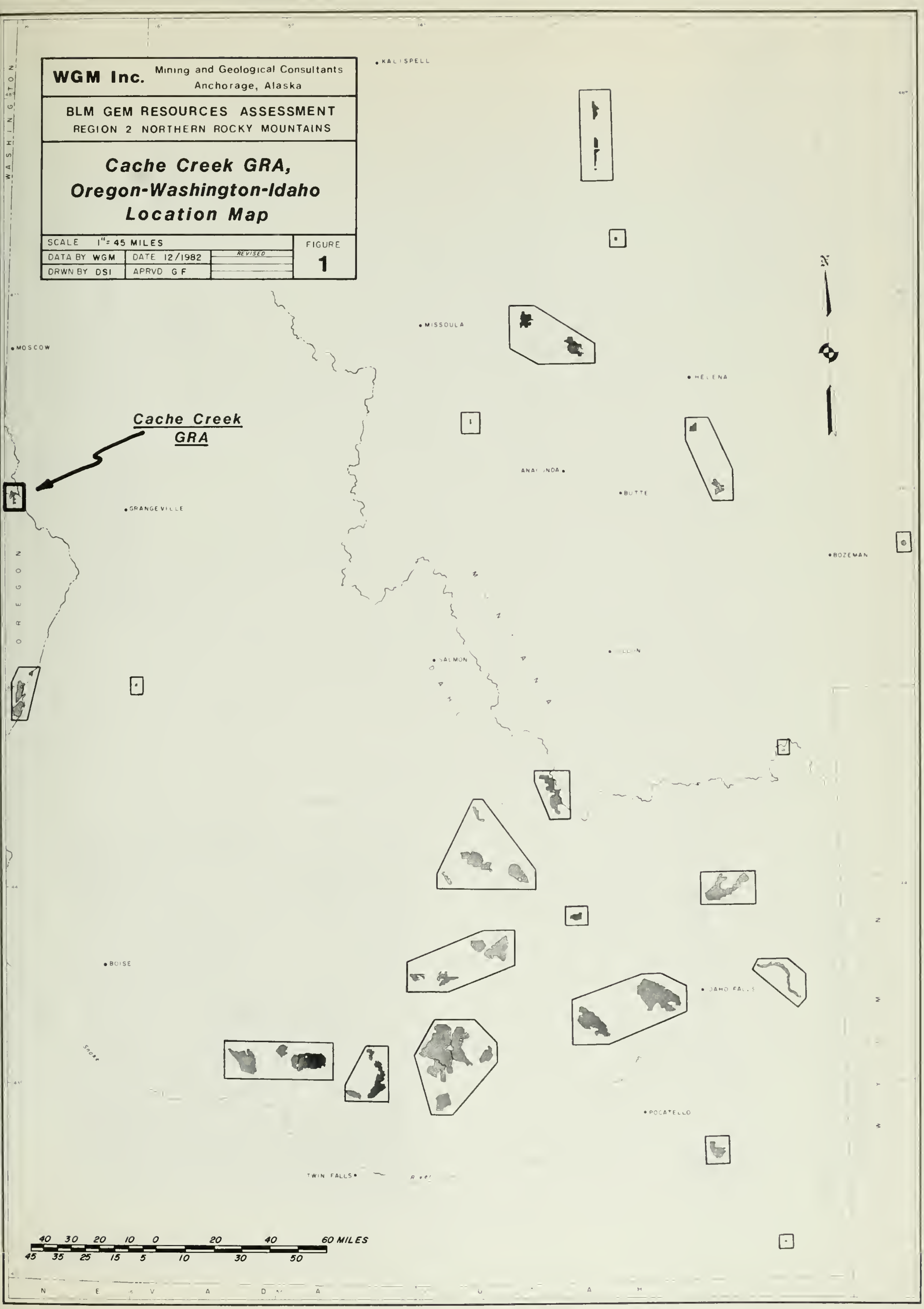
The Cache Creek GRA is located in northern Wallowa County Oregon, southern Asotin County Washington, and western Nez Perce County, Idaho (Fig. 1) in Ts.5-7N., Rs.46-47W. (Willamette Meridian) and Ts.30-31N, Rs.4-5W. (Boise Meridian). The Cache Creek Ranch Wilderness Study Area (WSA) comprising 2,935 acres is the only WSA in the GRA (Fig. 2). Administratively the area is within the Baker Resource Area in the Vale BLM district.

1.2 Population and Infrastructure

The Cache Creek GRA is approximately 27 miles south of the Lewiston, Idaho-Clarkston, Washington metropolitan area (pop. 35,000). No significant settlements are within the GRA. Anatone, Washington, 10 miles to the northwest, is the nearest settlement. Motor vehicle access is by way of State Highway 129 from Clarkston, Washington thence east along secondary roads to the Lime Hill-Downey Saddle-Cache Creek area. The area is also accessible by boat on the Snake River and mail is commonly delivered to residents along the Snake by this mode of transportation.

1.3 Basis of the Report

This report is based on a review, compilation and analysis of available published and unpublished geology, energy, and mineral resources of the



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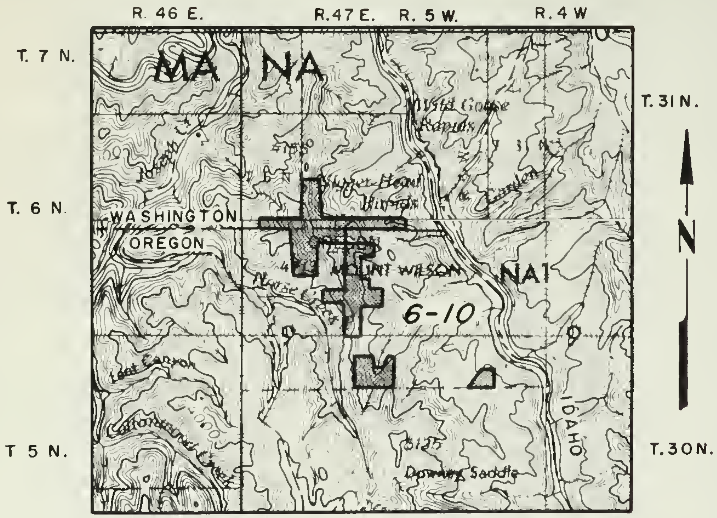
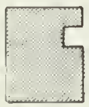
Anchorage, Alaska
BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS
Cache Creek GRA,
Oregon-Washington-Idaho
Location Map
SCALE 1"= 45 MILES
DATA BY WGM
DATE 12/1982
REVISED
DRWN BY DSI
APRVD G F
FIGURE
1
Cache Creek GRA
WASHINGTON
OREGON
KALISPELL
MOSCOW
MISSOULA
HELENA
GRANGEVILLE
BUTTE
BOZEMAN
SALMON
BOISE
POCATELLO
TWIN FALLS
40 30 20 10 0 20 40 60 MILES
45 35 25 15 5 10 30 50



BLM Wilderness Study Areas Included in the Cache Creek GRA.

WSA	NAME	ACREAGE
6-10	Cache Creek Ranch	2,935



Approximate Boundary of Wilderness Study Area.

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REGION 2 NORTHERN ROCKY MOUNTAINS

Cache Creek GRA, Oregon-Washington-Idaho Topographic Map

SCALE 1"=4 MILES (1:250,000)		FIGURE
DATA BY. WGM	DATE 9/1982	REVISED
DRWN BY DSI	APRVD G.F	2

Cache Creek GRA. Only small amounts of data are available upon which to base this study. Available data from academic institutions and the Idaho Bureau of Mines comprise the bulk of work in the area. The data was compiled and reviewed by WGM project personnel and the panel of experts to produce the resource evaluation which follows.

Personnel involve in the project and their general areas of responsibility are listed below:

Greg Fernette, Senior Geologist, WGM Inc.	Project Manager
C.G. Bigelow, President, WGM Inc.	Chairman, Panel of Experts
Joel Stratman, Geologist, WGM Inc.	Project Geologist
Jami Fernette, Land and Environmental Coordinator, WGM Inc.	Claims and Lease Compilation

<u>Panel of Experts</u>

C.G. Bigelow, President, WGM Inc.	Regional geology, metallic and minerals, mineral economics.
R.S. Fredericksen, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
David Blackwell, Ph.D., Professional of Geophysics, SOuthern Methodist University	Geothermal.
Jason Bressler, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
Gary Webster, Ph.D., Chairman, Department of Geology, Washington State University	Oil and gas.
William Jones, Senior Geologist, WGM Inc.	Metallic minerals, coal, industrial minerals.
J.F. McOuat, Presidents, Watts, Griffis & McOuat Ltd.	Mineral economics, Industrial minerals.
E.F. Evoy, Senior Geologists, Watts, Griffis & McOuat Ltd.	Uranium and thorium.

1.4 Acknowlegements

We would like to thank Bob Ciesil of the Baker BLM district for loaning us aerial photos and data on the region.

2.0 GEOLOGY

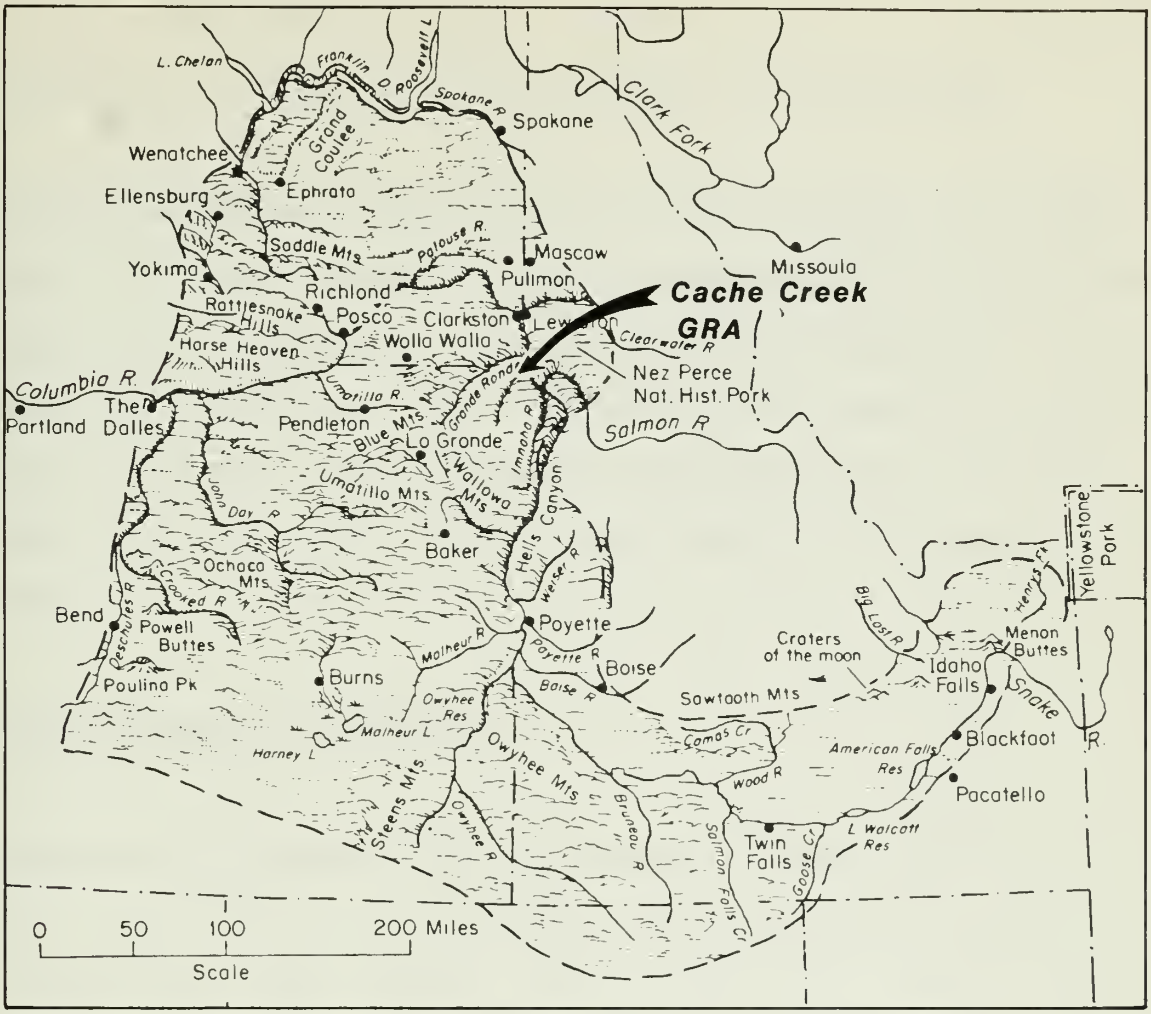
2.1 Introduction

Regionally the Cache Creek GRA lies on the north side of the Blue Mountains uplift. Much of the GRA is underlain by Tertiary (65-2 m.y.) plateau basalt flows. However, the dissected terrain along the Snake River Canyon exposes pre-Tertiary rocks of Triassic (230-195 m.y.) to Cretaceous (141-65 m.y.) age. Pre-Tertiary rocks include Triassic metavolcanic, volcaniclastic, limestone and clastic units, as well as Jurassic (195-141 m.y.) metapelites. Jurassic-Cretaceous granitic plutons intrude the Triassic to Jurassic marine rock units. Tertiary flood basalts unconformably overlie the older rock sequence. Mineral occurrences are restricted to the pre-Tertiary terrane. The limestone exposures have been exploited as a source of cement or lime, and granite bodies have been quarried for stone.

The southern half of the Cache Creek GRA has been mapped by Vallier (1973), the northeast side by Savage (1965), and portions of the eastern side by Shumway (1960) and Reidel (1978). Mineral occurrences on the Idaho side of the GRA have been compiled by Hustedde et al. (1981), and Strowd et al. (1981).

2.2 Physiography

The Cache Creek GRA is situated in the northeast portion of the Blue Mountains section of the Columbia-Snake River Plateau (Fig. 3) physiographic province (Hunt, 1974). The principal topographic and geomorphic feature in



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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Location of the Cache Creek GRA in the Columbia-Snake River Plateaus Physiographic Province (from Hunt, 1974).

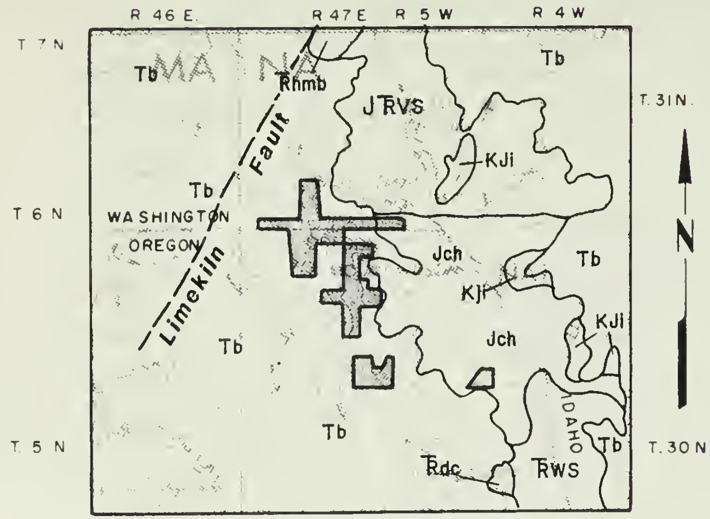
SCALE AS SHOWN			FIGURE
DATA BY	DATE 1/1983	REVISED	3
DRWN BY D.S.	APPRVD G.F.		

the GRA is the Snake River Canyon. Elevations range from 840 feet along the Canyon floor to 5,152 feet at Jim Creek Butte on the Canyon Rim.

Intermittent streams occupy most of the tributary canyons of the Snake River. The flow of the Snake itself fluctuates with the outflow of Hells Canyon Dam and depends upon irrigation requirements downstream. The Snake River Canyon area normally has mild winters and hot summers and essentially enjoys a semi-arid climate. Maximum precipitation occurs in the winter months and consists mostly of rain; annual precipitation averages 10 to 15 inches.

2.3 Description of Rock Units

The oldest rocks exposed in the GRA belong to the Middle (225-215 m.y.) to Late Triassic (215-195 m.y.) Wild Sheep Creek Formation (Figs. 4 and 5) of the Seven Devils Group (Vallier, 1973; Vallier, 1977). The Wild Sheep Creek Formation unconformably overlies the Hunsaker Creek Formation (not exposured within the Cache Creek GRA). The formation is distinguished by rugged outcrops, thick flow and volcaniclastic units, dark green and greenish-black colors on fresh surfaces, and a generally basaltic or andesitic composition. In general, three units can be distinguished within the Wild Sheep Creek Formation: (1) a lower volcaniclastic with kertaophyric (andesitic) compositions dominant; (2) a middle unit, mostly spilitic (basaltic) in composition, of massive pillowed flows and breccias; and (3) an upper unit which is a mixture of spilitic and kertophyric clastic rocks, argillite, and limestone. Maximum thickness of the Wild Sheep Creek Formation is estimated to be 7,620 feet (2,500 m). Fossils present within the formation support an



Data from Vallier, 1973; Glerup, 1960; and Gaston and Bennett, 1979.

Approximate Boundary of Wilderness Study Area.

EXPLANATION

CENOZOIC — Tertiary

- Tb - Plateau Basalts

MESOZOIC

Cretaceous

- KJi - Granitic Intrusive Rocks

Jurassic

- Jch - Coon Hollow Formation

Triassic (Seven Devils Group)

- Ŧ̄Rhmb - Hurwall and Martin Bridge Formation
- Ŧ̄Rdc - Doyle Creek Formation
- Ŧ̄Rws - Wild Sheep Creek Formation

- JŦ̄Rvs - undivided Coon Hollow Formation and Seven Devils Group

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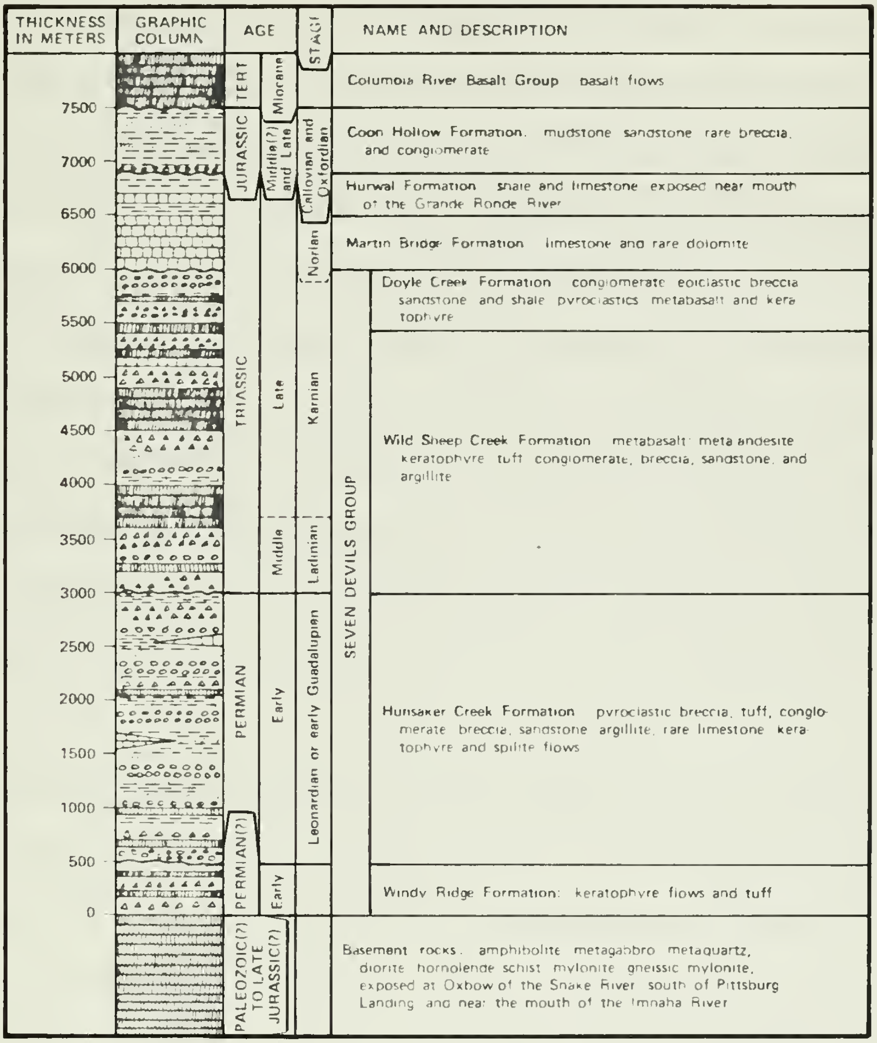
Cache Creek GRA, Oregon-Washington-Idaho

Geologic Map

SCALE 1" = 4 MILES			FIGURE 4
DATA BY	DATE 1/1983	REV SEQ	
DRWN BY DSI	APRVD G.F.		

COMPOSITE STRATIGRAPHIC COLUMN



Data from Vallier, 1977.

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Cache Creek GRA, Oregon-Washington-Idaho

Stratigraphic Column

DATE 1/1983
DRAWN DSI
APPR. GF

5

age of latest Middle Triassic and early Late Triassic. Base and precious metal occurrences are found in the Wild Sheep Creek Formation.

The Doyle Creek Formation is the uppermost formation of the Seven Devils Group. This formation is comprised of a sequence of red and green metamorphosed volcaniclastic rocks and volcanic flow rocks. Distinguishing features of the formation are the presence of red colors and the abundance of epiclastic sediments, both uncharacteristic of the underlying Wild Sheep Creek Formation. Formation contacts are however ill-defined and neither color or presence of epiclastics alone serve as distinguishing characteristics. The thickness is estimated at 1,525 feet (500 m). Age of the Doyle Creek Formation is bracketed as Late Triassic by overlying and underlying units. Base and precious metal occurrences are found within the Doyle Creek Formation.

The Martin Bridge Limestone lies stratigraphically above the Seven Devils Group. This unit includes limestone (sparite, biosparite, and micrite), dolomite, and limestone breccia. In the Snake River Canyon a basal unit of calcareous graywacke, siltstone, and argillaceous limestone is present. Approximately 1,615 feet (530 m) of Martin Bridge Limestone are present in the Snake River Canyon. Fossils are commonly well silicified and include ammonites of earliest Norian (Late Triassic) age.

The Hurwall Formation conformably overlies the Martin Bridge Formation and the contact is gradational. The Hurwal Formation was described (Smith and Allen, 1941) in the Wallowa Mountains as a shale and limestone unit of Late Triassic age but some Early Jurassic (195-176 m.y.) fossils have also been

[illegible]

found (Nolf, 1966). In the Snake River Canyon the Hurwal Formation has been mapped only near the mouth of the Grande Ronde River (Vallier, 1977; Glerup, 1960) where two distinct lithologies are present: (1) a lower unit made up of metamorphosed argillaceous limestone and argillite, and (2) an upper unit of metamorphosed mudstone and volcaniclastic rocks. In the Snake River Canyon no fossils have been found in the Hurwal, but it is regarded as Late Triassic. Both the Martin Bridge Formation and limestones within the Hurwal Formation have been exploited for manufacture of lime and cement which were transported down the Snake River on barges (Shumway, 1960; Savage, 1965).

Unconformably overlying the Triassic rock sequence is the Coon Hollow Formation. The formation has its type section within the Cache Creek GRA south of Little Cougar Creek (Jim Butte Creek 7½-minute quadrangle). Rock types are primarily black and dark-brown mudstone with minor siltstone and sandstone and rare beds of conglomerate and breccia. Fossils occur sparingly but provide a Middle (176-158 m.y.) to Late Jurassic (158-141 m.y.) age (Vallier, 1977). Thickness is unknown but is estimated to be about 1,830 feet (600 m).

Granitic dikes and plutons intrude the Seven Devils Group, Martin Bridge, Hurwal, and Coon Hollow Formations. These intrusives are generally believed to be outliers of the central portion of the Idaho batholith (Savage, 1965). The intrusives are biotite-quartz diorite and granodiorite bodies which commonly exhibit a gneissic structure. At Captain John Creek, six miles northeast of the Cache Creek GRA, huge blocks of Triassic limestone occur as large xenoliths. Although no age determinations have been made, workers have generally assumed a Cretaceous (Savage, 1965) or Jurassic-Cretaceous

age (Vallier, 1973) for the intrusives. The granite bodies have potential for contact metasomatic mineral occurrences and are suitable for dimension stone or road metal.

A profound unconformity, with relief of 500 to 700 meters, separates the pre-Tertiary rocks from the Miocene (23-6 m.y.) flood basalts. The old erosion surface is generally well exposed along the walls of the Snake River Canyon where boulder and cobble beds are commonly present at the unconformity. The package of Miocene flow basalts is known as the Columbia River Basalt Group. Along the Snake River Canyon two mappable units are present. The lowermost unit, a probable equivalent of the Picture Gorge basalt (Vallier, 1973; 1977), is composed of porphyritic basalt flows with a distinctive waxy luster on fresh surfaces. The thickest sections range from 610 to 1,370 feet (200 to 450 m). The upper unit, probably correlative with the Yakima Basalt, is comprised of a series of brown weathering, black basalt flows which attain a thickness of 2,745 feet (900 m) near the mouth of the Grande Ronde River.

Quaternary (2 m.y.-present) deposits in the Snake River Canyon are thin and discontinuous consisting mostly of landslide, terrace, and alluvial fan deposits.

2.4 Structural Geology and Tectonics

The dominant structural grain of the pre-Tertiary stratigraphy is N40° to 60°E (Fig. 4). Folding is a common structural feature. The Coon Hollow Formation is deformed into a series of northeast-trending anticlines and

synclines throughout most of its exposure. The dip of Triassic rocks is generally northwesterly.

A major fault, the Limekiln Fault, is present (Fig. 4) which strikes N25-30°E and has a displacement of up to 1,890 feet (620 m). In the Lime Hill area the Limekiln Fault juxtaposes Tertiary basalt on the northwest against Triassic sedimentary units to the southeast. The fault produces a topographic lineament traceable for 15 to 20 miles (Savage, 1965; Reidel, 1978). Latest movement on the Limekiln Fault occurred after eruption of the Columbia River Basalt Group.

Geologic hazards within the GRA result primarily from the steepness of the terrain. The main geologic hazard within the area consists of rock slides which disrupt travel on roads along the floor and sides of the Snake River Canyon. Rock slides commonly occur after unusually heavy downpours of rain and when spring melt waters saturate soils on the steep hill sides. Heavy summer thundershows also can cause flash floods which roar down the steeply incised tributaries of the Snake River with considerable destructive force. The area is not seismically active.

2.5 Paleontology

No systematic paleotological examination has been completed in the Cache Creek GRA and in general fossils appear to be relatively rare. Miocene plant fossils have been found in clay, ash, and silt beds (Latah members) of the Columbia River Basalt Group (Savage, 1965). Fossils are quite rare in

the Coon Hollow Formation although in an area near the Washington-Oregon border about 410 feet (125 m) above the base of the formation fragments of the ammonite genus Cardioceras have been found (Vallier, 1977). The Martin Bridge Formation, which commonly contains well a preversed fossil assemblage, contains few fossils in the Lime Hill area. Fragments of crinoid stems and a depauperate fauna of gastrapoda, pelecypoda, and ammonites are present (Savage, 1965).

2.6 Historical Geology

The Late Paleozoic and Triassic rock units found within the Cache Creek GRA are part of the Wrangellia tectonostratigraphic terrane (Jones et al., 1982). The Wrangellia terrane, now found as dismembered Permo-Triassic blocks in Oregon-Idaho, Canada and Alaska, originated about 300 million years ago as an island arc formed by volcanic activity distant from any continent. Most of the base and precious metal deposits contained within the Seven Devils Group were formed during this period of volcanic activity. Fusulinids and paleomagnetic data indicate that Wrangellia originated at low paleolatitudes presumably east of the Tethyan realm in the Panthalassa Ocean, the predecessor of the Pacific. As volcanic activity waned and the arc cooled it sank and was covered by shallow-water sediments. About 220 million years ago the terrane rifted and was covered by thick accumulations of basalt establishing an emergent platform. These basalts which are present elsewhere in Wrangellia terrane are not found in the Snake River Canyon area. They may have been removed erosion or they may be represented by the andesitic volcanics of the Wild Sheep Creek Formation. In the Triassic the entire platform subsided below sea level where shallow water

[illegible]

[illegible]

[illegible]

carbonates (i.e. the Martin Bridge Formation) and later, deep marine sediments (i.e. the Hurwal and Coon Hollow(?) Formations) were deposited. The Wrangellia terrane, carried forth on the Pacific plate, began to collide with the North American plate in Cretaceous time. Rock units were dismembered by faulting, deformed, and eventually accreted to the North American plate. Faulting, generally strike-slip, has greatly attenuated the Wrangellia terrane, scattering segments from Oregon to south-central Alaska.

Orogenic activity culminated in Late Triassic accompanied by Jurassic-Cretaceous plutonism which gave rise to a second metallogenic process creating contact metasomatic mineral deposits and remobilizing earlier formed volcanogenic mineral deposits. Post-orogenic erosion produced mountains of some relief. In Miocene time a tensional tectonic regimen in the Pacific Northwest brought about the great outpourings of the Columbia River basalts which completely buried the hilly terrain. Late Tertiary Oliogecene (38-23 m.y.) to Pliocene (6-2 m.y.), uplift of the Blue Mountains area and subsequent erosion are responsible for the present relief. The Snake River crosses the Blue Mountain uplift in Hells Canyon creating the present exposures on which this interpretation is based.

3.0 ENERGY AND MINERAL RESOURCES

3.1 Introduction

Data on known energy and mineral deposits and occurrences was compiled through review of all available data. Principal sources are the U.S. Bureau of Mines MILS Data File, the USGS CRIB File, and publications by Strowd et al. (1981), Hustedde et al. (1981), Close et al. (1982), Savage (1965), and Shumway (1960). The Cache Creek GRA contains 18 known mineral occurrences and prospects.

3.2 Known Mineral and Energy Deposits

The Cache Creek GRA contains one mineral deposit, the Treasure Group (loc. 18, Fig. 6, Table I), located near the mouth of Jim Creek in Section 11, T.5N., R.47E. (Close et al., 1982). Reserves are estimated at 2,400 tons averaging 0.006 oz/ton Au, 0.27 oz/ton Ag, and 0.27% copper. The deposit is apparently a volcanogenic lens in volcanics of the Seven Devils Group. No known mineral deposits occur in the Cache Creek Ranch WSA.

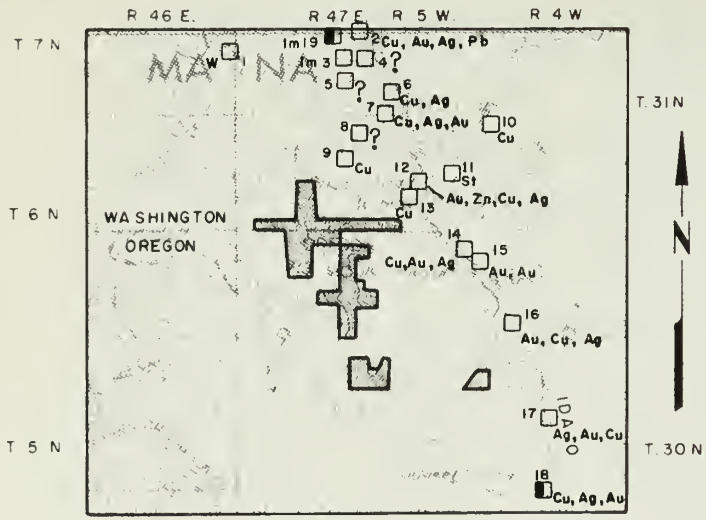
The Cache Creek GRA contains deposits of limestone suitable for use of lime and cement manufacture . These deposits located at Lime Hill (loc. 19, Fig. 6, Table I), and just beyond the boundary of the GRA at Lime Point, were exploited prior to 1900 as indicated by wood-fired kilns in the Lime Point-Lime Hill area which still stand today. The kilns produced small amounts of lime and natural cement which were transported down the Snake River on barges (Shumway, 1960). The deposits at Lime Hill were studied by

TABLE I

MINES, MINERAL DEPOSITS, AND MINERAL OCCURRENCES OF THE CACHE CREEK GRA

Map No.	Name*	Location Sec.	T.	R.	Commodity	Type	Ref.
1	Joseph Creek	26	7N	46E	W	?	USBM-MILS
2	Mammoth Copper	29	7N	47E	Cu-Au-Ag-Pb	?	USBM-MILS
3	Pollyann Limestone	30	7N	47E	Lm	Lm	USBM-MILS
4	Lime Hill Prospects	29	7N	47E	No data	?	USBM-MILS
5	Unnamed	31	7N	47E	No data	?	USBM-MILS
6	Unnamed	32	7N	47E	Cu-Ag	?	USBM-MILS
7	Unnamed	32	7N	47E	Cu-Ag-Au	?	USBM-MILS
8	Goldfield 1 and 3	5	6N	47E	No data	?	USBM-MILS
9	Shovel Creek	6	6N	47E	Cu	?	USBM-MILS
10	Evening Star	18	31N	4W	Cu	?	USBM-MILS
11	Corral Creek Granite Quarry	24	31N	5W	Stone	Granite	Hustedde, et al. (1981)
12	Warm Springs Group	9	6N	47E	Au-Zn-Cu-Ag	?	USBM-MILS
13	Unnamed	9	6N	47E	Cu	?	USBM-MILS
14	Cache Creek Rapids Adit	36	31N	5W	Cu-Au-Ag	?	USBM-MILS
15	Yellowboy Mine	36	31N	5W	Au-Ag	?	USBM-MILS
16	Little Cougar Creek Adit	6	30N	4W	Au-Cu-Ag	?	USBM-MILS
17	Cottonwood Creek Adit	18	30N	4W	Ag-Au-Cu	?	USBM-MILS
18	Treasure Group	11	5N	47E	Cu,Ag,Au	Vol.	Close, et al. (1982)
19	Lime Hill	19,20, 30	7N	47E	Lm	Lm	Shumway (1960)

* Deposits underlined.



LEGEND

■ Mineral Orebody

◧ Mineral Deposit

□ Mineral Occurrence

Active Quarry

Inactive Quarry

Active gravel or clay pit

Inactive gravel or clay pit

1 □ Cu — occurence number — commodity

Ag - Silver
Au - Gold
Cu - Copper
W - Tungsten
Zn - Zinc
lm - Lithium minerals
St - Stone

Approximate Boundary of Wilderness Study Area.

5 4 3 2 1 0 3 6 Miles

5 4 3 2 1 0 5 10 Kilometers

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BLM GEM RESOURCES ASSESSMENT REGION 2 NORTHERN ROCKY MOUNTAINS	
Cache Creek GRA, Oregon-Washington-Idaho	
Mineral Occurrences	
SCALE 1" = 4 MILES	FIGURE 6
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Shumway (1960) who estimated that 748,000,000 short tons of useable limestone is present. Analyses of the limestone show the following ranges:

CaO	40.61 - 51.11%
SiO_2	2.10 - 21.68%
R_2O_3*	0.84 - 1.88%
MgO	0.50 - 3.71%
P_2O_5	0.014 - 0.093%
Ignition loss	33.92 - 48.81%

* $R_2O_3 = Al_2O_3+Fe_2O_3$

Savage (1965) examined the Lime Point area deposits which are in Idaho one mile northeast of Lime Hill, Washington. Savage concluded that these deposits contain probable reserves of over 626,000,000 short tons of commercial-grade carbonate rock suitable for production of portland cement, argicultural lime, and other commerical uses. Analyses of the limestone show the following results Savage, 1965:

CaO	53.3%
SiO_2	2.5%
R_2O_3	0.8%
MgO	0.8%
P_2O_5	0.035%

There are no known energy deposits in the Cache Creek GRA.

[illegible]

[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	
[illegible]	[illegible]	

[illegible]

[illegible]

[illegible]

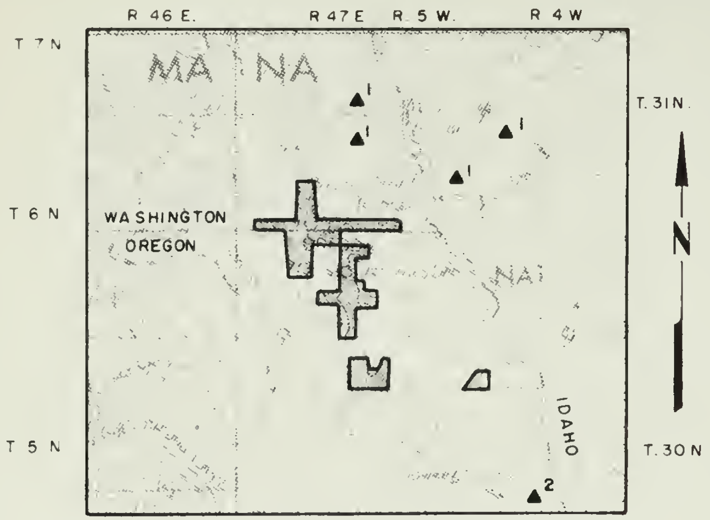
3.3 Known Mineral and Energy Prospects, Occurrences, and Mineralized Areas

Very little data on mineral occurrences is available for the Cache Creek GRA other than name, location, and commodities present. Thus the geologic character, mineral deposit type, etc. is unknown for the majority of occurrences. Table I lists deposits and mineral occurrences in the GRA. Most metallic mineral occurrences are copper or copper-gold-silver with minor amounts of lead or zinc present and virtually all are located in pre-Tertiary rocks of Triassic to Jurassic age. One occurrence, Joseph Creek (loc. 1, Fig. 6) is apparently a tungsten occurrence but may be a placer accumulation of unknown derivation. None of these occurrences are in the Cache Creek Ranch WSA.

One quarry, the Corral Creek granite quarry (loc. 11, Fig. 6, Table I), is located in the Cache Creek GRA on Corral Creek in Cretaceous granitic rocks. No other data is available.

No mineral occurrences are known in the Cache Creek Ranch WSA.

No tests for hydrocarbon source or reservoir beds have been made in the region. No hydrocarbon test wells have been drilled within the Cache Creek GRA, and two wells (Breckenridge, 1982),drilled approximately 25-30 miles east-northeast of the Cache Creek GRA, were abandoned as dry holes. No deep stratigraphic tests have been made within the region. About 10 miles west of the Cache Creek GRA, a sedimentary sequence interbedded with basalt contains a lignite bed (Stoffel, 1981).



EXPLANATION

▲ Unpatented Mining Claim

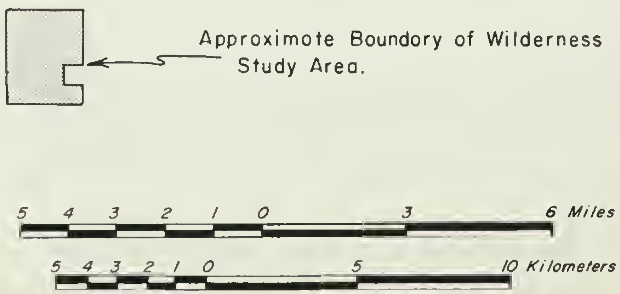
x Patented Mining Claim

Notes: 1) Number adjacent to symbol indicates number of mining claims in that section.

2) Area of search: Entire GRA

3) Source of Data: BLM Claims Microfiche

4) Data current to: June 7, 1982 (Id.)
August 7, 1982 (Wa., Or.)



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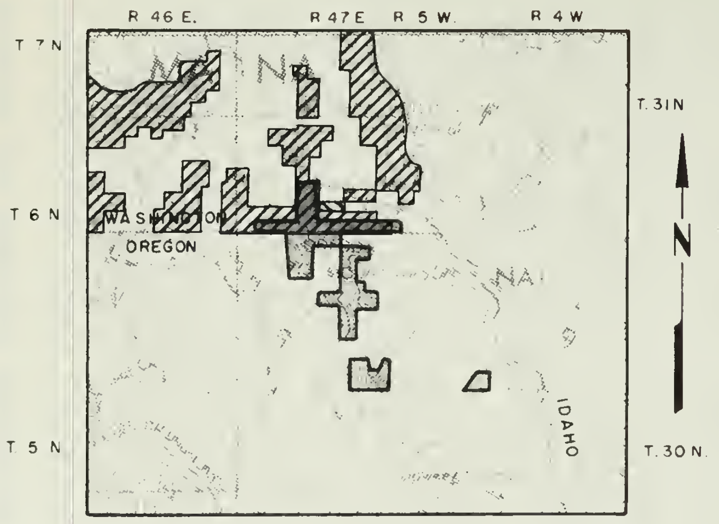
BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Cache Creek GRA,
Oregon-Washington-Idaho

Mining Claims Density Map

SCALE 1" = 4 MILES			FIGURE
DATA BY WGM	DATE 1/1983	REV. SED	7
DRWN BY DSI	APRVD G.F		



LEGEND

Area covered by oil and gas leases.

Area covered by oil and gas lease application.

Notes: 1) Area of Search: Entire GRA
2) Data current to: BLM Status Plats
3) Source of Data: August 7, 1982

Approximate Boundary of Wilderness Study Area.

5 4 3 2 1 0 3 6 Miles

5 4 3 2 1 0 5 10 Kilometers

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Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Cache Creek GRA, Oregon-Washington-Idaho

Oil and Gas Lease Status

SCALE 1" = 4 MILES			FIGURE
DATA BY WGM	DATE 1/1983	REVISED	8
DRWN BY DSI	APRVD G.F.		

There are no heat flow/gradient data close to the Cache Creek GRA. Cook Creek hot spring, with an exit temperature of 36°C and a flow of 30 liters per minute, occurs about six miles south of the Cache Creek Ranch WSA (Riccio, 1978; Geothermal Resources of Oregon, 1982). No chemical analyses are available for the Cook Creek hot spring. However, the vertical permeability of the Columbia River basalts which underlie most of the WSA is generally low; thus, upflow of hot water into the basalt should only occur along major fracture zones. Much of the area is probably above the water table and any water that does occur is probably trapped along permeable interflow contact zones in the basalt; therefore, it is unlikely that a geothermal system can develop.

3.4 Mining Claims, Leases, and Material Sites

A search of active mining claims in the Cache Creek GRA revealed the presence of six claims; data is current through June 7, 1982 for Idaho and August 7, 1982 for the Washington and Oregon portions of the GRA (Fig. 7). Applications for oil and gas leases (Fig. 8) cover portions of the Cache Creek Ranch WSA (6-10) in Washington as well as much of the rest of the Cache Creek GRA in Washington.

3.5 Mineral and Energy Deposit Types

All lode mineral deposits are in Triassic to Jurassic age volcanics and marine sedimentary units. The commodities present, primarily copper-gold-silver, are characteristic of a large number of similar showings throughout the Snake River Canyon. In areas studied in more detail, these mineral showings are generally considered to be veins or volcanogenic-type mineral

occurrences. One deposit, the Treasure Group in the Jim Creek, Oregon area is classified by Close et al. (1981) as a volcanogenic lens. Most other occurrences in the Triassic-Jurassic rock sequence are probably also volcanogenic- or vein-type mineral occurrences as well. No contact metasomatic occurrences are known in the area. Savage (1965) does note however that the granites in the Cache Creek GRA do contain some small veins with small amounts of copper sulfides some of which reportedly contain gold and/or silver.

Most of the copper-gold-silver occurrences in rocks belonging to the Seven Devils Group are probably similar to the volcanogenic mineralization in the Homestead GRA seventy miles south of the Cache Creek GRA. Two of these deposits, the Copper Cliff and Iron Dyke, are currently being mined. The majority of the volcanogenic mineral prospects and occurrences in the Homestead GRA contain copper mineralization although various amounts of lead, zinc, silver, and gold are present in some locales. Copper minerals commonly found include chalcopyrite, bornite, and chalcocite. Tetrahedrite has been noted locally. Oxidation commonly produces malachite, azurite, rarely native copper, secondary chalcopyrite and chrysocolla. The red andesite units found within the Doyle Creek Formation commonly host primary chalcocite accumulations as at the Lime Peak mine and several occurrences on Copper Creek. Copper occurrences within the Hunsaker Creek Formation and Wild Sheep Creek Formation are more commonly dominated by chalcopyrite with lesser bornite and chalcocite (Federicksen, 1982).

It is unlikely that economic concentrations of uranium are present in the Cache Creek GRA. The basic volcanic composition and the marine character of

the sediments provide an unfavorable geological setting for uranium deposits.

The igneous and metamorphic rocks in the Cache Creek GRA have no potential for the accumulation of hydrocarbon resources. There is a possibility that potential hydrocarbon accumulation might occur if any favorable reservoir beds formed on the eroded igneous and metamorphic surface which was covered by the Miocene basalts. However, extensive stream erosion has cut through the basalts at many places in the region and no intervening sediments have yet been recognized.

Lake beds and lignites in the interbedded sedimentary sequences within the Miocene basalts could be potential hydrocarbon source beds, however, they have probably not undergone sufficient thermal maturation to generate hydrocarbons. The sandstones within the interbeds could also be potential hydrocarbon reservoir beds. In the Cache Creek GRA, however, erosion has cut through the basalts and interbeds destroying any potential traps.

The regional subsurface structure and stratigraphy of the pre-Miocene strata are not well understood. It is possible that potential reservoirs are present at depth within the Cache Creek GRA and surrounding region. A pluton just north of the Oregon-Washington border extends to the west where it is covered by the basalt (Webster, mapping in progress). This pluton clearly underlies the northern part of the Cache Creek Ranch WSA eliminating any hydrocarbon potential for that part of the WSA.

[illegible]

3.6 Mineral and Energy Economics

The overall geological setting of the Cache Creek GRA is conducive to development of small high grade volcanogenic deposits such as those found at the Iron Dyke mine and Copper Cliffs mine within the Homestead GRA, seventy miles south. Most likely any copper deposits present in the area would contain significant precious metal contents. The precious metal contents would increase the economic viability of the mining operation despite stagnant base metal prices.

Limestone and dolomite have a variety of uses including aggregate, cement, lime, building stone, fluxes, glass material, refractories fillers, abrasives, soil conditioners and many others. The generally low unit value of most limestone and dolomite dictates that production and transportation costs be low (Carr and Rooney, 1975); thus, distance to market is a major factor in the operational economics of quarries for common varieties of limestone and dolomite. High calcium limestone (95% $CaCO_3$) and high purity dolomite (40% $MgCO_3$) which have a variety of uses in the chemical and metallurgical industries are less common and hence have a higher unit value than most grades of limestone and dolomite (Brobst and Pratt, 1973). As a result they can be shipped much greater distances. Portland cement grade limestone is present in Sections 19, 20 and 30, T.7N., R.47E.

4.0 LAND CLASSIFICATION FOR GEM RESOURCES POTENTIAL

4.1 Explanation of Classification Scheme

In the following section the land in the Cache Creek Ranch WSA is classified for geology, energy and mineral (GEM) resources potential. The classification scheme used is shown in Table II. Use of this scheme is specified in the contract under which WGM prepared this report.

The evaluation of resource potential and integration into the BLM classification scheme has been done using a combination of simple subjective and complex subjective approaches (Singer and Mosier, 1981) to regional resource assessment. The simple subjective approach involves the evaluation of resources based on the experience and knowledge of the individuals conducting the evaluations. The complex subjective method involves use of rules, i.e. geologic inference, based on expert opinion concerning the nature and importance of geologic relationships associated with mineral and energy deposits (Singer and Mosier, 1981; Table II).

The GEM resource evaluation is the culmination of a series of tasks. The nature and order of the tasks was specified by the BLM, however, they constitute the general approach by which most resource evaluations of this type are conducted. The sequence of work was: (1) data collection, (2) compilation, (3) evaluation, and (4) report preparation. No field work was done in the Cache Creek GRA.

TABLE II

BUREAU OF LAND MANAGEMENT GEM RESOURCES LAND CLASSIFICATION SYSTEM

CLASSIFICATION SCHEME	LEVELS OF CONFIDENCE
1. The geologic environment and the inferred geologic processes do not indicate favorability for accumulation of mineral resources.	A. The available data are either insufficient and/or cannot be considered as direct evidence to support or refute the possible existence of mineral resources within the respective area.
2. The geologic environment and the inferred geologic processes indicate low favorability for accumulation of mineral resources.	B. The available data provide indirect evidence to support or refute the possible existence of mineral resources.
3. The geologic environment, the inferred geologic processes, and the reported mineral occurrences indicate moderate favorability for accumulation of mineral resources.	C. The available data provide direct evidence, but are quantitatively minimal to support or refute the possible existence of mineral resources.
4. The geologic environment, the inferred geologic processes, the reported mineral occurrences, and the known mines or deposits indicate high favorability for accumulation of mineral resources.	D. The available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources.

4.2 Classification of the Cache Creek Ranch (6-10) Wilderness Study Area

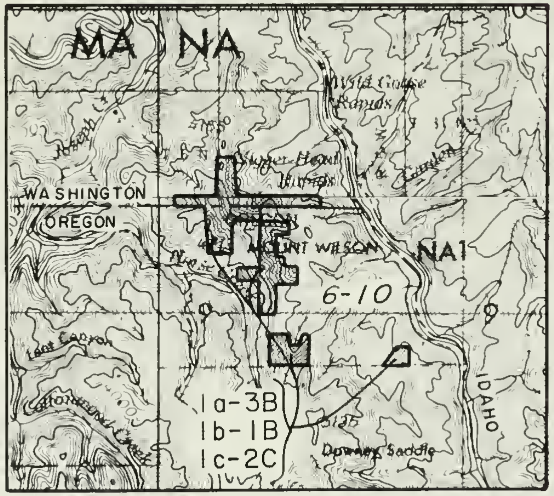
4.2.1 Locatable Minerals

Locatable minerals are those which are locatable under the General Mining Law of 1872, as amended, and the Placer Act of 1870, as amended. Minerals which are locatable under these acts include metals, ores of metals, non-metallic minerals such as asbestos, barite, zeolites, graphite, uncommon varieties of sand, gravel, building stone, limestone, dolomite, pumice, pumitice, clay, magnesite, silica sand, etc. (Maley, 1983).

4.2.1a Metallic Minerals. All of WSA (6-10)(1a, Fig. 9) is classified as having moderate potential for metallic mineral resources based on indirect evidence (3B). The geologic setting is similar to the setting of the Iron Dyke and Copper Cliff mines, seventy miles south, and a number of mineral prospects and occurrences are present adjacent to the WSA.

4.2.1b Uranium and Thorium. The entire area of WSA (6-10) (1b, Fig. 9) is classified as unfavorable for uranium and thorium based on indirect evidence (1B) . The basic volcanic environment present in the GRA is not favorable for the development of economic uranium concentrations.

4.2.1c Non-Metallic Minerals. WSA (6-10) (1c, Fig. 9) is classified as having low favorability for non-metallic minerals based on limited direct evidence (2C). None of the WSA is underlain by near-surface limestones and occurrences of other non-metallic minerals are absent in similar geologic environments elsewhere in the region.



BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

EXPLANATION

1 a - 4D

Area I.D. Number (1); Commodity (a); Classification (4); Level of Confidence (D)

a) Metallic Minerals
b) Uranium and Thorium
c) Non-Metallic Minerals

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Cache Creek GRA, Oregon-Washington-Idaho
Wilderness Study Area
Land Classification
Locatable Resources

SCALE 1" = 4 MILES (1:250,000)			FIGURE 9
DATA BY WGM	DATE 9/1982	REVISED	
DRWN BY DSI	APRVD G.F		

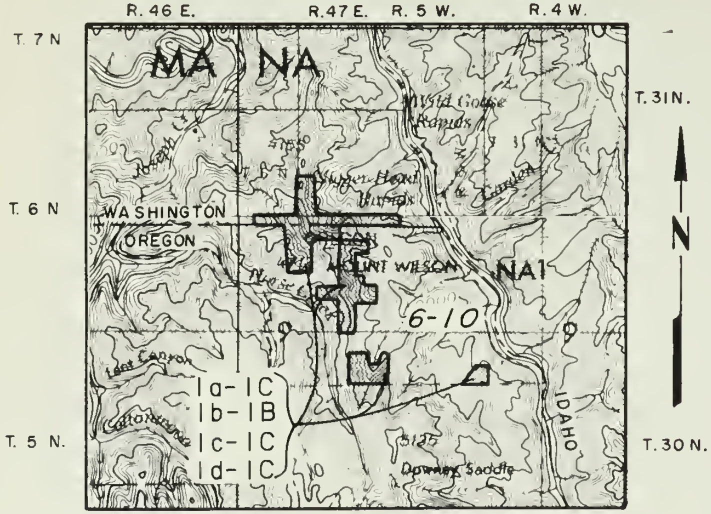
4.2.2 Leasable Resources

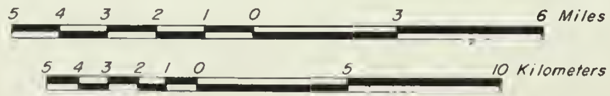
Leasable resources include those which may be acquired under the Mineral Leasing Act of 1920 as amended by the Acts of 1927, 1953, 1970, and 1976. Materials covered under this Act include: asphalt, bitumen, borates and sodium and potassium, carbonates of sodium and potassium, coal, natural gas, nitrates of sodium and potassium, oil, oil shale, phosphate, silicates of sodium and potassium, sulfates of sodium and potassium, geothermal resources, etc. (Maley, 1983).

4.2.2a Oil and Gas. The entire area of WSA (6-10) (1a, Fig. 10) is classified as unfavorable for oil and gas resources based on limited direct evidence (1C). The basis of the classification is the generally unfavorable regional and local geologic setting of the WSA.

4.2.2b Geothermal. All of WSA (6-10) (1b, Fig. 10) is classified as unfavorable for the occurrence of both low and high temperature geothermal resources based on indirect evidence (1B). The basis of the classification is the generally low vertical permeability of the Columbia River basalts and the lack of favorable conditions for the development of geothermal circulation.

4.2.2c Sodium and Potassium. WSA (6-10) (1c, Fig. 10) is classified as unfavorable for the occurrence of sodium and potassium based on limited direct evidence (1C). The geologic environment of the WSA is generally unfavorable for these deposits.





Approximate Boundary of Wilderness Study Area.

BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

EXPLANATION

I a - 4D

- I: Area I.D. Number
- a: Commodity
- 4: Classification
- D: Level of Confidence

a) oil and gas

b) Geothermal: high temperature (H), Low temperature (L)

c) Sodium and Potassium

d) others: Asphalt (As) bitumen (bt), phosphate (ph), No specific commodity designation indicates that the rating applies to all of the above.

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Cache Creek GRA, Oregon-Washington-Idaho
Wilderness Study Area Land Classification Leasable Resources

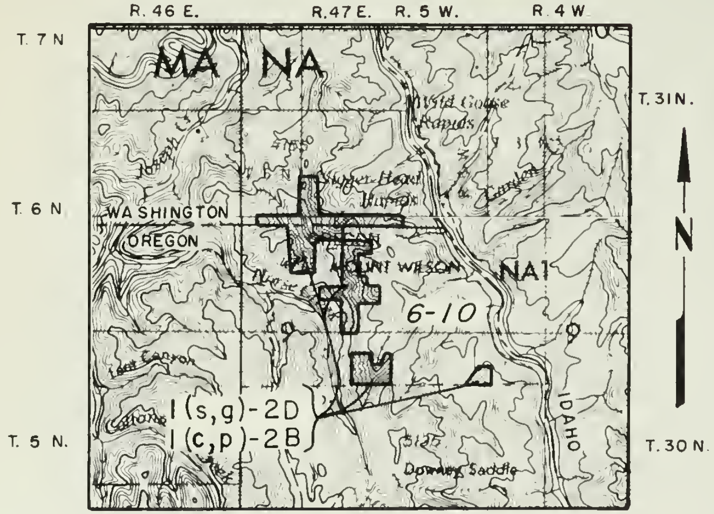
SCALE 1" = 4 MILES (1:250,000)		REVISED	FIGURE
DATA BY WGM	DATE 9/1982		10
DRWN BY DSI	APRVD G.F		

4.2.2d Others. All of WSA (6-10) (1d, Fig. 10) is classified as unfavorable for the occurrence of asphalt and bitumen based on limited direct evidence (1C).

4.2.3 Saleable Resources

Saleable resources include those which may be acquired under the Materials Act of 1947 as amended by the Acts of 1955 and 1962. Included under this Act are common varieties of sand, gravel, stone, cinders, pumice, pumicite, clay, limestone, dolomite, peat and petrified wood (Maley, 1983).

WSA (6-10) (1(s,g), Fig. 11) is classified as having low favorability for the occurrence of sand and gravel based on direct evidence (2D). The entire area of WSA (6-10) (1 (c,p), Fig. 11) is classified as having low favorability for occurrence of pumice and cinders based on indirect evidence (2B).



BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

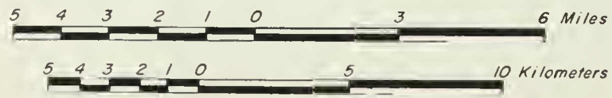
EXPLANATION

1(ls) - 4D

- 1 — Area I.D. Number
- ls — Commodity
- 4 — Classification
- D — Level of Confidence

s	Sand
g	Gravel
st	Stone
c	Cinders
p	Pumice
pt	Pumicite
cl	Clay
ls	Limestone
dl	Dolomite
P	Peat
pw	Petrified wood

Approximate Boundary of Wilderness Study Area.



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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Cache Creek GRA, Oregon-Washington-Idaho
Wilderness Study Area
Land Classification
Saleable Resources

SCALE 1" = 4 MILES (1:250,000)			FIGURE 11
DATA BY WGM	DATE 9/1982	REVISED	
DRWN BY DSI	APRVD G.F		

5.0 RECOMMENDATIONS FOR FURTHER STUDY

The best base and precious metal potential in the GRA is present within Seven Devils Group which contains a significant number of mappable lithologies. A detailed geologic map at a scale of 1:12,000 should be made of the Seven Devils Group within the GRA. Emphasis should be upon defining and tracing the volcanic stratigraphy and upon defining associated mineralization. A reconnaissance stream silt survey would help delineate mineralized areas.

Characterization of potential hydrocarbon source beds and thermal maturation studies of the Mesozoic sediments and interbeds in the basalts should be made within the region. This will provide more complete information on potential source and reservoir rocks within the area. However, these studies will probably not be of benefit to the Cache Creek Ranch WSA.

A further assessment of geothermal potential would require a spring geochemical reconnaissance program.

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